GAS CHROMATOGRAPHY

55780y **Gas chromatographic determination of carbon monoxide and carbon dioxide. Investigations from the gas phase of cigarette smoke.** Klimisch, Hans J.; Meissner, Klaus; Wernicke, Helga (Forschungsinst., Cigarettenind. e. V., Hamburg, Ger.). *Z. Lebensm.-Unters. Forsch.* **1975**, 157(6), 339–43 (Ger). A gas chromatog. method for the quant. detn. of CO and CO_2 was described. The method was suitable in a wide sensitivity range from ppm to percent content of these gases. CO, CH_4, and CO_2 were sepd. under isothermic working conditions by the use of a column filled with carbon mol. sieve CMS. The column should be regenerated only after >1000 analyses. The quant. detn. of CO and CO_2 in cigaret smoke was reported. With a total retention time of <1 min, this system permitted the anal. of the carbon oxides to be performed puff by puff. The CO and CO_2 contents of the vapor phase of various test cigarets were discussed.

Chemical Abstracts 83: 55780y.

130646c **Chemical studies on tobacco smoke. XXIV. Quantitative method for carbon monoxide and carbon dioxide in cigaret and cigar smoke.** Brunnemann, Klaus D.; Hoffmann, Dietrich (Naylor Dana Inst. Dis. Prev., Am. Health Found., New York, N. Y.). *J. Chromatogr. Sci.* **1974**, 12(2), 70–5 (Eng). A method for the gas chromatog. detn. of CO and CO_2 in cigaret and cigar smoke was developed. Aliquots of the total smoke or the smoke of an individual puff were injected via a dual gas sampling loop onto a mixed packing column. Initially CO_2 was sepd. from CO, N_2 and O_2 on silica gel; a subsequent oxidn. of CO to CO_2 on an iodine pentoxide layer resulted in the sepn. of CO (as CO_2) from N_2 and O_2. The exptl. variation of the ref. gas was 1.9% for CO and 2.0% for CO_2. The technique was applied to the smoke anal. of com. and exptl. tobacco products and yielded std. deviations of <4% for com. cigarets. The amt. of CO and CO_2 increased linearly with the puff no. Results of various exptl. cigarets are discussed as well as the possibility of reducing the toxicity of tobacco smoke by decreasing the amt. of CO.

Chemical Abstracts 80: 130646c.

45787e **Use of carbosieve-b chromatography packing for the determination of carbon monoxide and carbon dioxide in cigaret smoke.** Morie, Gerald P. (Tennessee Eastman Co., Div., Eastman Kodak Co., Kingsport, Tenn.). *Tob. Sci.* **1973**, 17, 125–6 (Eng). Pub. in Tobacco 175(18), 51–2. A method is described for the detn. of CO and CO_2 by gas chromatog. using a single column packed with Carbosieve B, a carbon mol. sieve. The temp. is held at 30° for 3 min and then programmed to 100° at 12.5 degrees/min. Coeffs. of variation of 2.7 and 1.7% for CO and CO_2, resp., were obtained. Nonfilter, filter, and vented-filter cigarets were studied. The amts. of CO and CO_2 found in the smoke were in agreement wih those found by longer, more complex analyses.
A. M. Gottscho

Chemical Abstracts 80: 45787e.

45789g **Concentration of carbon monoxide in cigaret smoke.** Pillai, M. Aiyappan; Gupta, M. C. (Dep. Mech. Eng., Indian Inst. Technol., Madras, India). *Chem. Age India* **1973**, 24(5), 265–7 (Eng). CO was detd. in cigaret smoke at different rates of air flow and for different cigaret lengths. Factors which lead to incomplete combustion and higher CO concn. and ways to avoid these conditions are discussed.
A. P. Som

Chemical Abstracts 80: 45789g.

133444a **Determination of carbon monoxide and carbon dioxide in cigaret smoke.** Reif, H.; Kuhn, H. (Austria Tabakwerke A.-G., Vienna, Austria). *Fachliche Mitt. Oesterr. Tabakregie* **1973**, 14, 239–51 (Ger). An app. is described for the complete and direct detn. of *carbon monoxide* [630-08-0], *carbon dioxide* [124-38-9], *oxygen* [7782-44-7], *nitrogen* [7727-37-9], and *methane* [74-82-8] in cigaret smoke. The one channel app. contains, in sequence, a smoking machine, smoke-collection balloon, electromagnetic valve, and gas chromatograph equipped with a 1 m column filled with a 5 Å mol sieve. When tested oriental tobacco burned more slowly, and produced slightly less CO than Virginia, Burley, or cigar tobacco. CO prodn. was increased by addmixt. with puffed or sheet tobacco, but unaffected by addmixt. with synthetic tobacco. Increased paper porosity, or inclusion of a ventilation zone or selective filter in the cigaret also reduced CO prodn. Thus, CO in cigaret smoke may be controlled better by altering cigaret prepn. (paper, filter, etc.), than the tobacco blend. However, synthetic tobacco can be used to lower the tar and nicotine content of cigarets without increasing CO prodn.

Chemical Abstracts 79: 133444a.

121571f **Gas-chromatographic determination of carbon monoxide in cigaret smoke.** Klimisch, H. J.; Meissner, K. (Forschungsinst., Cigarettenind. e. V., Hamburg, Ger.). *Beitr. Tabakforsch.* **1972**, 6(5), 216–19 (Ger). A routine gas chromatog. method for the detn. of CO in tobacco smoke employs a mol. sieve column in which the CO is hydrogenated in the presence of a Ni catalyst at 290°. The column is coupled to a flame ionization detector, and has the advantage of high stability and sensitivity. Two types of smoking machine were compared, a const. flow model and one operated by pistons, in which the smoke was trapped in a plastic container full of satd. NaCl soln. Addn. of 8% $NaNO_3$ caused a 30% redn. in the CO value; filters had no effect on this value. The 2 smoking machines gave comparable results.
S. M. Hopkinson

Chemical Abstracts 78: 121571f.

108334m **Use of cryogenic temperature gas chromatography for determination of carbon monoxide and carbon dioxide in cigaret smoke.** Morie, Gerald P.; Sloan, Cephas H. (Res. Lab., Tennessee Eastman Co., Kingsport, Tenn.). *Beitr. Tabakforsch.* **1972**, 6(4), 178–81 (Eng). A gas chromatog. method for the detn. of CO and CO_2 in cigaret smoke was developed. A column contg. Porapak Q packing and a cryogenic temp. programmer employing liq. N to cool the column to subambient temps. was used. The sepn. of N, O, CO, and CO_2 was accomplished at temps. of −70 to 40°, and the org. vapor phase of smoke was analyzed as the column temp. was programmed to 220°. The inorg. gases were detected by thermal conductivity and the org. vapors by flame ionization. The method was used to det. the amts. of CO and CO_2 in the smoke of nonfilter, filter, and vented-filter cigarets and to analyze the org. vapor phase of smoke.
Dinabandhu Mishra

Chemical Abstracts 78: 108334m.

106455z **Routine determinations on the gas phase of cigaret smoke.** Donzel, Michael; Testa, Albert. *Ann. Dir. Etud. Equip., SEITA (Serv. Exploit. Ind. Tab. Allumettes), Sect. 1* **1970**, 7, 157–66 (Fr). Previously the gas phase of cigaret smoke was analyzed colorimetrically. This proved both laborious and inaccurate because of the instability of the smoke compn. A special smoking app. was designed which allows rapid collection of the smoke and injection into a capillary column for gas chromatog. Compds. of major interest are CH_3CHO, isoprene, CH_3CH_2CHO, $(Me)_2CO$, acrolein, MeCN, MeCOEt, C_6H_6, and $CH_3C_6H_5$.
A. M. Gottscho

Chemical Abstracts 73: 106455z.

PM3000859038

110975v Determination of carbon monoxide in tobacco smoke. Kruszynski, A. J.; Henriksen, A. (Skand. Tobakskompagni A. S., Copenhagen, Den.). *Beitr. Tabakforsch.* 1969, 5(1), 9–12 (Ger). After a review of several methods used for the detn. of CO in tobacco smoke, results from gas-chromatographic studies are reported. A calibration curve was prepd. from pure CO. The smoke of cigarets which contained a mixt. of Burley tobacco contained 4.8–8.1 vol. % CO, whereas those without Burley tobacco contained less CO, 3.5–7.1 vol. %. The presence of sugar reduced the amt. of CO present in the smoke, 3.8 and 5.1 vol. % present with 12 and 6% sugar, resp. The CO content increased from puff to puff: 6.5 and 8.3 vol. % CO at the 2nd and 6th puff, resp. Cigaret wt. had no influence on CO in the smoke. This applies also to the humidity of the tobacco or, the acetate or C filters. However, puff vol. and perforation of the cigaret paper influenced the CO yield significantly. CSJG

Chemical Abstracts 71: 110975v.

10091k Obtaining gaseous components of tobacco smoke and its application to carbon monoxide determination in smoke. Harke, Hans P.; Drews, C. J. (Inst. Wiss. Forschungsstelle, Verband Cigarettenind., Hamburg, Ger.). *Beitr. Tabakforsch.* 1968, 4(7), 275–7 (Ger). A method was developed for keeping the anal. smoking conditions of a single cigaret const. and for collecting the gaseous components of tobacco smoke. The trap consisted of a 1-l. glass vessel with 2 openings and was filled with a satd. NaCl soln. At 1 opening the cigaret was attached to the vessel interconnected by a Cambridge filter. Through the 2nd opening 35 ml. of the NaCl soln. was siphoned off in 1 min. intervals within 2 sec., thus soaking in the tobacco smoke. After shaking the vessel to obtain a mixt. of the gases, differentially reconstituted cigarets with the same blend mixt. were used to investigate the CO content of the gaseous mixt. by gas chromatog. The method can also be used for the detn. of other gaseous smoke components. U. B. Schulz

Chemical Abstracts 71: 10091k.

65112c Application of gas chromatography to tobacco smoke analysis. Keith, Charles H. (Celanese Fibers Co., Charlotte, N.C.). *Theory Appl. Gas Chromatogr. Ind. Med., Hahnemann Symp., 1st* 1966 (Pub. 1968), 243–51 (Eng). Edited by Kroman, Henry S. Grune and Stratton: New York, N.Y. The major applications of gas chromatog. to tobacco smoke anal. are reviewed. The anal. of condensable smoke vapors for hydrocarbons and other volatile components and for specific components and additives, such as nicotine, menthol, humectants, phenols, and water, the anal. of gases, and the anal. of nonvolatile smoke components, including phenols, acids, alcs., esters, ketones, and polycyclic hydrocarbons are discussed. 39 references. DVJN

Chemical Abstracts 70: 65112c.

Analytical methods for determination of chemical components in tobacco smoke. I. Determination of carbon monoxide and carbon dioxide in cigaret smoke by gas chromatography. Mihoko Watanabe and Yusuke Kobashi (Nippon Senbai Kosha Chuo Kenkyusho, Tokyo). *Nippon Senbai Kosha Chuo Kenkyusho Kenkyu Hokoku* No. 107, 177–80(1965)(Japan). Cigaret smoke was filtered through a Cambridge filter and analyzed by gas chromatography. A stainless steel column 4.5 mm. × 3 m. length was packed with silica gel (40–60 mesh), followed by a 20 cm. layer of iodine pentoxide, then 1 cm. of Ag powder. Addnl. silica gel was packed in the rest of the column. CO in the injected smoke was oxidized to CO_2 by iodine pentoxide in the middle of the column; thus, it eluted sep. from air. With this system, at 115° and helium flow rate 20 ml./min., retention times of air, CO, and CO_2 were 4, 8, and 11 min., resp. The reduced iodine in the column was trapped by the Ag powder. Concns. of CO and CO_2 and their peak heights were linear in 2–10 ml. and 3–18 ml./100 ml. air, resp. No significant difference was found in many tested cigarets, either domestic or foreign. Concns. of CO and CO_2 were ~4 and 10%, resp., under the condition of 35-ml. puffs of 2-sec. duration once per min. Y. Kishimoto

Chemical Abstracts 64: 18043g.

Variations of the gas phase composition within a burning cigaret. J. R. Newsome and C. H. Keith (Liggett & Myers Tobacco Co., Durham, N. Car.). *Tobacco Sci.* 9, 65–9(1965) (Eng). A technique and an app. for measuring the concn. of the major gaseous components at various points within a burning cigaret during puffing is described. The relative amts. of H_2, O_2, N_2, CH_4, CO_2, and CO were detd. by this method. Just behind the burning cone there is essentially no O_2, but the mixt. is rich in reducing gases. As the distance from the cone increases, the mixt. is dild. with air drawn in around the cone and through the paper wrapper, and this dilu. accounts for the changes in concns. of the gaseous components. A. M. Gottscho

Chemical Abstracts 63: 13715b.

Determination of carbon monoxide in cigarette smoke by gas chromatography. R. C. Mumpower, J. S. Lewis, and G. P. Touey (Tennessee Eastman Co., Kingsport). *Tobacco Sci.* 6, 140–3(Pub. in *Tobacco* 155, No. 8, 30–3(1962)). The gaseous phase of cigaret smoke, after removal of H_2O and CO_2, was injected into a gas chromatographic column and the CO content was detd. using a thermal cond. cell as detector and H_2 as carrier gas. With a non-filter, king-size cigaret, the CO in the 3rd puff averaged 3.1%, the 8th and 13th puffs were 4.4 and 5.0%, resp. The overall av. per cigaret was 4.2%. Increasing moisture content of the tobacco smoked had no significant effect on the CO concn. in the smoke; an increase in puff vol. at const. duration produced a increase of CO concn. When the cigaret paper was coated with Al, the smoke of the cigaret contained 130% more CO. A series of com. brands, of varying sizes, with and without filters were examd. for the CO contents in their smokes. The concn. of CO ranged from 3.0 to 5.0%. A. M. Gottscho

Chemical Abstracts 57: 17091e.

Separation of hydrogen, oxygen, nitrogen, methane, and carbon monoxide by gas adsorption chromatography. George Kyryacos and C. E. Boord (Ohio State Univ., Columbus). *Anal. Chem.* 29, 787–8(1957).—The O_2 consumption and the light gas products of a *cool flame*, produced by a stoichiometric mixt. of n-C_6H_{14} and air at 270°, were estd. on a 16-ft. column contg. mol. sieve operated at 100°, with He as the carrier gas. P. H. Latimer

Chemical Abstracts 51: 10177h.

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